

Changes in soil properties and possibilities of reducing environmental risks due to the application of biological activators in conditions of very heavy soils

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Abstract This study aims to verify the effect of farmyard manure (FYM) and selected activators (Z'fix and NeoSol) on changes of soil properties. Their application should lead to improvement in specific soil physical properties and of organic matter fixation to reduce the environmental risks, or tillage energy requirements, respectively. Experimental field was divided into variants (0.7 ha each) as follows: I (FYM with Z'fix); II (FYM with Z'fix + NeoSol); III (FYM); IV (Control NPK only). FYM application rates were: 50 t ha⁻¹ (2014); 30 t ha⁻¹ (2016). Additional NPK fertilizer (I–IV) was applied according to annual crop nutrient normative. The agent Z'fix was used as an activator of FYM biological transformation (5.5 kg t⁻¹). The agent NeoSol was used as soil activator (200 kg ha⁻¹; annually). In order to verify the effect, cone index, bulk density, tillage implement draft and chemical soil components (Humus, C/N ration and N_{tot}) were measured annually. Compared to the control, the application of FYM combined with investigated agents (I–III) increased N_{tot} more than two times. Moreover, it decreased (I–III) bulk density by 8.7%. Tillage implement draft decreased by 3% after the application of FYM with Z'fix (I, II). The study confirmed that FYM application combined with examined activators has a positive impact on soil fertility and helped to reduce environmental risks.

Materials and Methods

- 2014 – 2018
- an agricultural plot near the Městec Králové town in the Central Bohemia – Czech Republic
- 150 x 45 m per each variant – 0.7 ha
- Gleyic Phaeozem

Chemical and physical characteristics of soil 2014	Soil depth (m)	
	0.00–0.30	0.30–0.60
Clay (< 0.002 mm) (%)	48	60
Silt (0.002–0.05 mm) (%)	32	39
Very fine sand (0.05–0.10 mm) (%)	2	1
Fine sand (0.10–0.25 mm) (%)	18	0
Soil texture (USDA)	clay	clay
Humus content (%)	3.89	1.44
Bulk density (g cm ⁻³)	1.46	1.48
Total porosity (%)	46.15	43.99
Volumetric moisture (%)	35.65	40.20
CEC – cation exchange capacity (mmol kg ⁻¹)	278	272
pH (H ₂ O)	7.50	7.82
pH (KCl)	7.18	7.21

- cone index (spring term) – Penetrometer PEN 70 (CULS Prague) – according to ASABE standards
- soil bulk density (spring term)– Kopecky cylinders (volume of 100 cm³)
- volumetric moisture – Theta Probe (Delta-T Devices Ltd, UK)
- draft (after harvest)– drawbar dynamometer with strain gauges S-38/200kN/ (LUKAS, the Czech Republic)
- sample rate – 0.1s – NI CompactRIO (National Instruments Corporation, USA)
- Soil samples for chemical analysis were taken at two depths (0–0.15 m and 0.15–0.30 m)
- NPK – 15-15-15 (Lovofert, Czech Republic)
- NeoSol (PRP Technologies, France)
- Z'fix (PRP Technologies, France)

Variant	Fertilization	Application rates for production year and crop (t ha ⁻¹)			
		2014/15	2015/16	2016/17	2017/18
		silage maize	spring barley	winter wheat	silage maize
I	FYM ^A with Z'fix	50	0	30	0
II	FYM with Z'fix + NeoSol ^B	50 + 0.2	0 + 0.2	30 + 0.2	0 + 0.15
III	FYM	50	0	30	0
IV	Control - NPK only	according to crop demand and local practice			

^AFarmyard manure of cattle origin

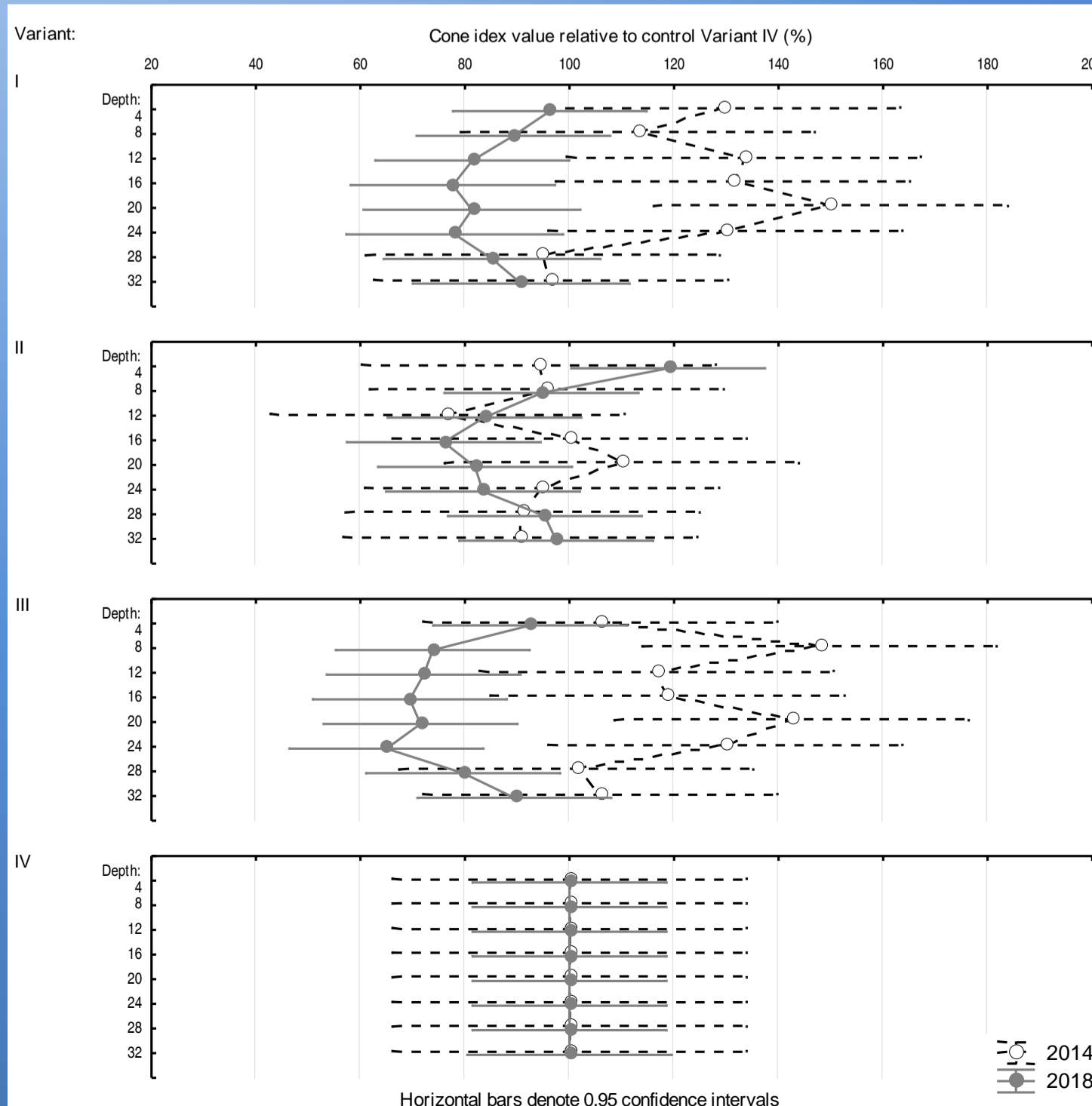
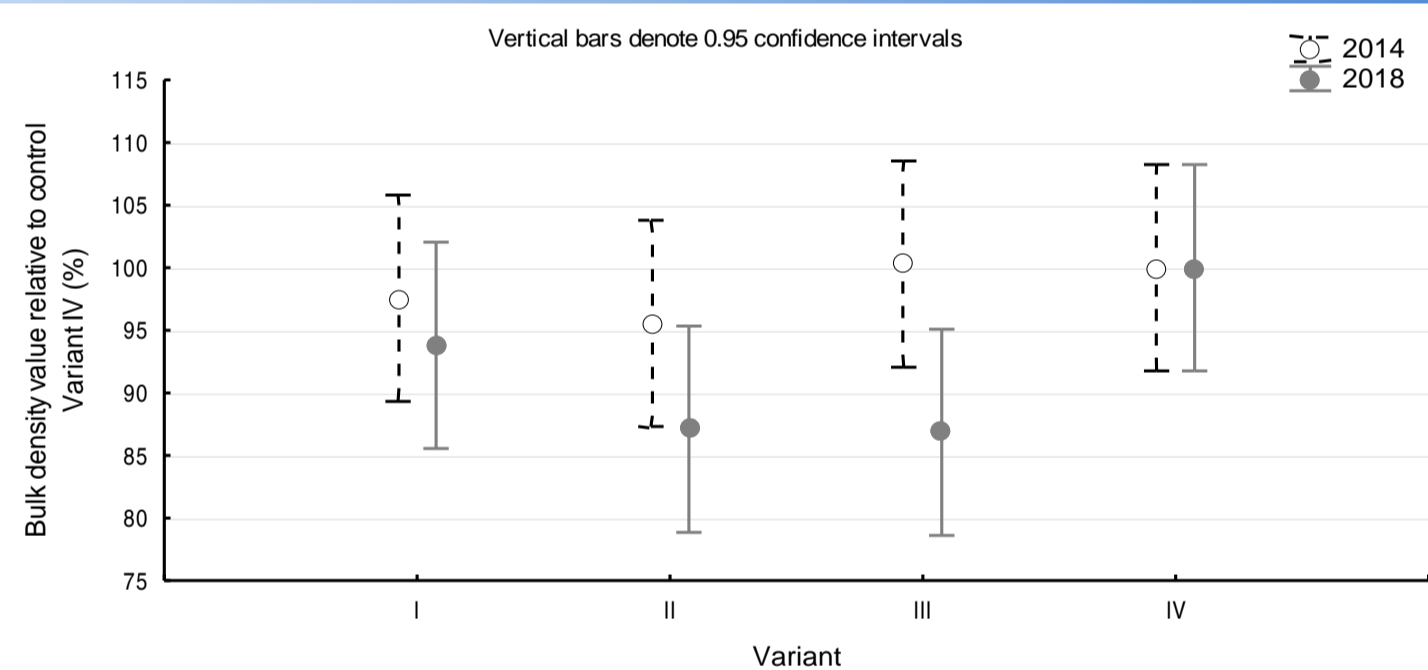
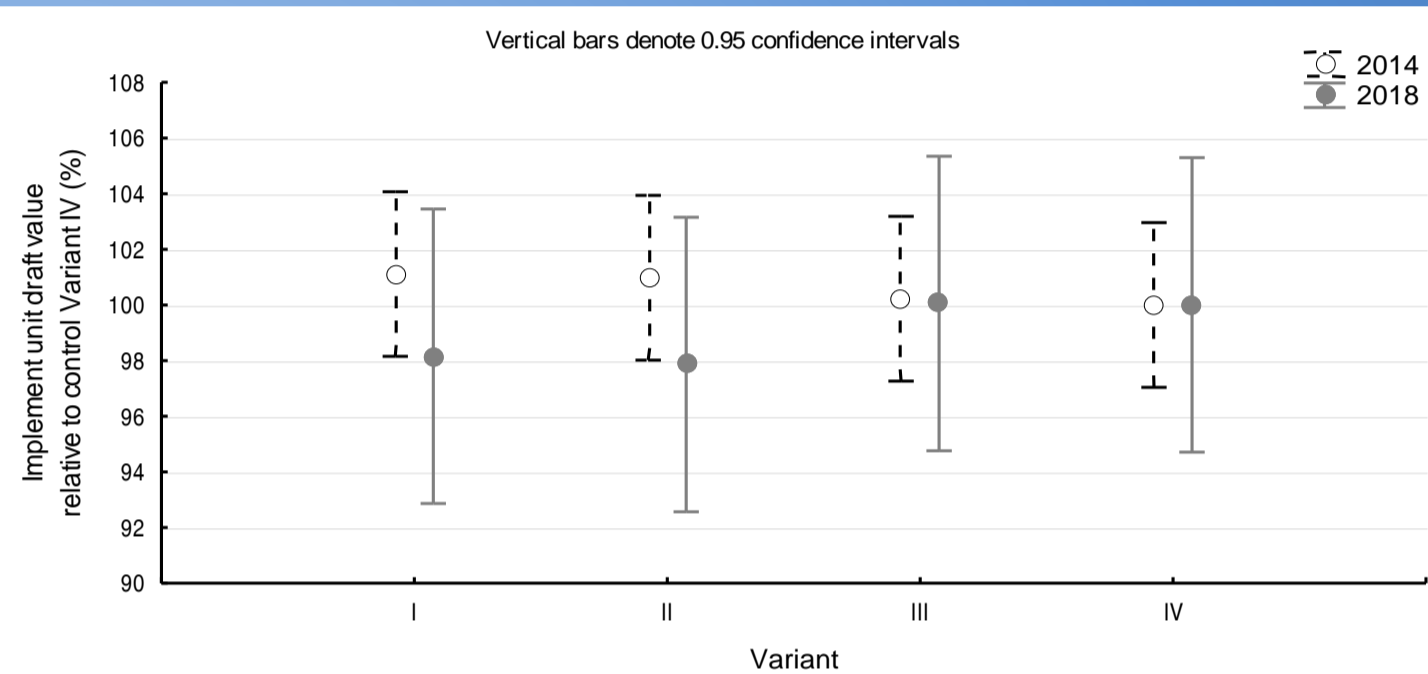
^BModified activator NeoSOL has been used with a changed dosage from the year 2017 onwards (formerly PRP SOL)

- Data processing – Trimble Business Center (Trimble, USA), MS Excel (Microsoft Corp., USA) and Statistica (Statsoft Inc., USA)

Conclusion

- the farmyard manure (FYM) and the activators showed positive effect
- FYM with Z'fix decreased unit implement draft by 3%
- application of FYM treated with Z'fix also most of all increased the total nitrogen content
- the activators of organic matter should be examined further

Results



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